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Salient features of the Grameen Shakti renewable energy program

Muhammad Asif*, Dipal Barua

School of the Built and Natural Environment, Glasgow Caledonian University, Cowcaddens Road, Glasgow, G4 0BA, United Kingdom

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ABSTRACT

Bangladesh is one of the developing countries in the world which faces severe energy and environmental challenges. Grameen Shakti is a micro-generation renewable energy program that aims to meet energy requirements of the people of Bangladesh in a cost effective and environmentally friendly manner. It is one of the largest and fastest growing programs of its type in the world. Presently, Grameen Shakti deals with three technologies: solar home systems (SHSs), biogas systems and improved cooking stoves (ICS). This article looks into the prominent features of Grameen Shakti program which have primarily contributed to its success.

Contents

1. Introduction

Energy is one of the most basic of commodities in the present age. It is a prerequisite for the economic, social, industrial, agricultural and infrastructural growth of every nation. Despite such an important role of energy, a large proportion of the global population faces serious energy challenges. Mostly coming from Asia and Africa, over 1.5 billion people in the world have no access to electricity and around 3 billion people rely on traditional biomass such as wood, charcoal, dung, and agricultural residue for cooking applications [1]. Access to sufficient, affordable and consistent supplies of electricity and other refined forms of energy is absolutely fundamental to promote sustainable development in these parts of the world. Renewable energy is a promising candidate to address these energy problems.

Grameen Shakti (GS) is one of the largest micro-generation renewable energy programs in the world which started in 1996 in order to provide affordable and environmentally friendly energy to the people of Bangladesh. Over the years, owing to its innovative business model and operational framework, GS has experienced

* Corresponding author. Tel.: +44 141 331 8721; fax: +44 141 331 3696.
E-mail address: Muhammad.asif@gcu.ac.uk (M. Asif).

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remarkable success. This article explores the salient features of the GS program in order to establish its key indicators of success. It also reflects upon the lessons that can be learnt from the GS program for the benefit of similar programs in other parts of the world.

2. Country profile of Bangladesh

Bangladesh is one of the developing countries in the world which sits in South Asia with geographic coordinates of 23 43N and 90 24E. With a total area of 143,998 km^2, the country is situated between Burma and India and has a coastline of 580 km along the Bay of Bengal. It is one of the most populated countries in the world – according to 2010 estimates, it has a population base of 164.5 million. With a figure of 1085 persons/km^2, the country is ranked 5th in the world in terms of population density [2]. Rural areas contribute to around 73% of the total population. With a per capita GDP of US$1,600, Bangladesh's economy is largely agriculture-based and is supported by crops like rice, wheat, jute, tea, sugarcane and tobacco. In recent years, the country has made substantial progress in the export of garments. In the fiscal year 2009, the export of garments for making up US$12.3 billion and remittances from overseas Bangladeshis totaling $9.7 billion accounted for almost 25% of GDP [3]. Monsoon flooding is a major problem for the economic development of the country which annually affects almost one third of the country.

3. Energy and environmental challenges

Bangladesh faces serious energy challenges as it has limited indigenous resources. The per capita commercial energy consumption of the country is about 200 kg of Oil Equivalent (kgOE), around 66% of which comes from natural gas, with the remainder being mainly contributed by oil, coal and hydropower [4]. Local oil and coal reserves are very small compared to the demand – according to 2009 statistics, more than 94% and 45% of the respective needs were met through imports [5]. Gas reserves, however, are reported to be potentially relatively healthy and all of the national requirements were met locally. Bangladesh heavily relies on biomass based traditional fuels most of which exist outside the commercial net – estimates suggest that almost 55% of the primary energy needs are met by fuels like fuel wood, charcoal, leaves, animal dung and agricultural residues.

The installed power generation capacity in the country is 5269 MW. More than 97% of the electricity is generated from thermal power while the rest is contributed by hydropower. Lack of access to electricity is one of the major issues affecting the socio-economic conditions of people. According to International Energy Agency statistics, nearly 96 million people, making up 38% of the total, do not have access to electricity [6]. While some other estimates suggest that only 32% of the total population is connected to national electric grid [7]. After India, Bangladesh has the largest population base in the world without access to electricity as shown in Table 1 [8]. In terms of per capita electricity consumption, the country has a ranking of 177 in the world with an annual value of 148 kWh [9,10]. The poor availability of electricity is a major hindrance to the economic prosperity in the country as is also suggested by Fig. 1 that presents a direct correlation between access to electricity and the economic well-being of a range of countries [11].

Owing to the limited economic and infrastructural resources of Bangladesh, the extension of national grid is taking place at a very slow rate. Furthermore, the difficult terrain in some parts of the country poses many problems towards the extension of high-tension transmission lines. For similar reasons, the supply the gas to the rural areas through pipelines is also not economically viable. Renewable energy is now increasingly being considered as an appropriate alternative to meet the energy requirements in the areas far from electric and gas networks.

Table 1
Countries with a large population without access to electricity.

Country/region	Population without electricity	
	Millions	% of world total
India	487.2	34.6
Bangladesh	96.2	6.8
Indonesia	101.2	7.2
Nigeria	71.1	5.0
Pakistan	71.1	5.0
Ethiopia	60.8	4.3
Congo	53.8	3.8
Myanmar	45.1	3.2
Tanzania	34.2	2.4
Kenya	29.4	2.1
World total	1410	100.0

Bangladesh also faces a string of extremely serious environmental challenges including floods, cyclones and droughts. Issues like soil degradation and erosion, deforestation and water born diseases also add to the catalog of challenges. In the United Nation's list of countries under severe threat by global warming, Bangladesh is on the top. Analysts suggest that, being a low-lying and densely populated country, Bangladesh would be worst hit by any rise in the sea level. Coastal areas would experience erosion and inundation due to intensification of tidal action. A rise in seawater will enable saline water to intrude further inland during high tides. Destruction of agricultural land and loss of sweet water fauna and flora could also occur. The shoreline would retreat inland, causing changes in the coastal boundary and coastal configuration. Worst scenarios suggest that by the year 2050, one-third of the country could be under water, making more than 70 million people homeless [12].

4. Salient features of Grameen Shakti

Grameen Shakti was established as a not-for-profit organization in 1996 to promote environmentally friendly and affordable energy technologies. Emphasis was placed to address the needs of people living in rural and remote areas without access to national electricity and gas networks. Grameen Shakti is now one of the largest and fastest growing micro-generation programs in the world. Initially it employed solar photovoltaic technology to install solar home systems (SHSs). Presently, it also deals with biogas systems and improved cooking stoves (ICSs). Owing to its rapidly expanding capacity in terms of trained human resource and infrastructure, over the years, these technologies have experienced a remarkable growth. It is estimated that around 3.5 million people are benefiting from the services of Grameen Shakti [13].

4.1. Renewable technologies being offered

4.1.1. Solar home systems

The electricity grid has a weak penetration in Bangladesh especially in rural areas where only 10% of the population has access to it. People without access to electricity rely mostly on kerosene lanterns for lighting needs. Having realized the importance of electricity in the socio-economic well being of people, Grameen Shakti initiated the solar home system (SHS) program in Bangladesh in 1996. Solar home systems have gained immense success both within the domestic and commercial sector. A SHS is attractive to customer for a number of reasons. It is, for example, a cost effective alternative to grid electricity and has a very little running cost. Solar home systems present numerous benefits to customers in comparison to traditional choice of kerosene lanterns. A SHS, for example, provides much brighter light while being more cost effective. It

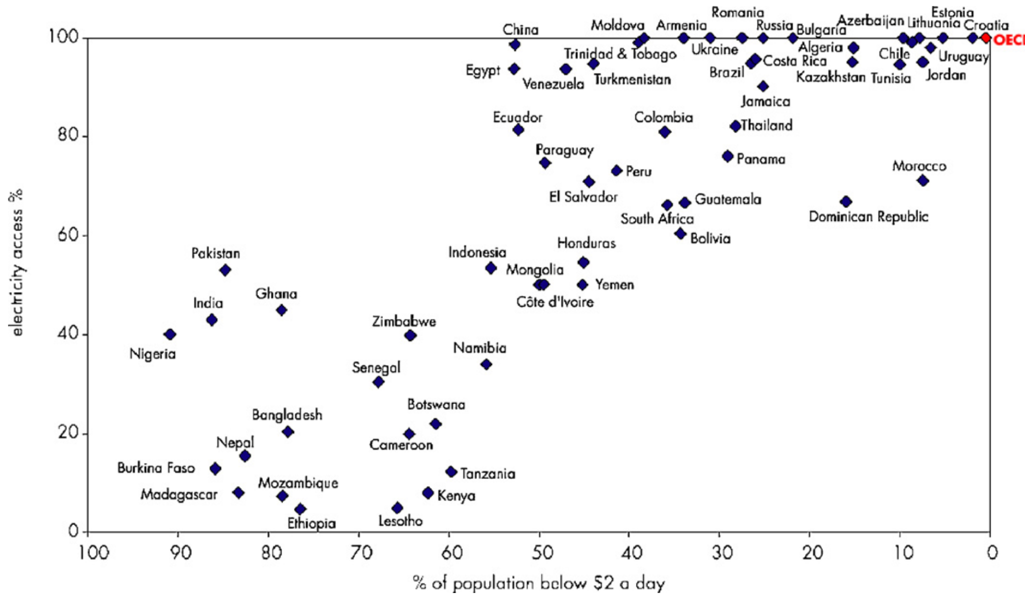


Fig. 1. Relationship between economic prosperity and availability of electricity.

improves the indoor health conditions as, contrary to kerosene lanterns, SHSs do not produce any toxic fumes. It also benefits the education of children as they can study under brighter light for longer hours. A SHS also reduces fire hazards. In case of kerosene lights, customer needs to fetch oil, sometimes from as far as several kilometers, on a regular basis. A SHS thus adds to the convenience of customer also by putting a stop to this practice. Mobile charger and television are almost essential features of all SHSs which have revolutionized communication in rural areas. Both the television and mobile chargers have also benefited the community relationships – it is, for example, a common practice that the people in the neighborhood of a SHS will sit together to watch TV. Micro-utility solar home systems have also played an important role in strengthening community relationships.

Solar home systems have also contributed to income generation and its enhancement. Women have found new opportunities to earn money through local cottage industry. Similarly, shop keepers, for example, can have their shops open for extended hours. For the stated benefits, solar home systems are very attractive to rural communities. The success of SHSs is evident from the fact that the cumulative number of the installed systems has jumped from 228 in 1997 to over 520,000 in 2010 as shown in Fig. 2. Towards the end of 2010, Grameen Shakti was installing 20,000 systems per month [14].

4.1.2. Biogas systems

In Bangladesh, the pipeline network of natural gas is extremely limited – the gas pipelinereaches out to only about 3% of the total population. The situation forces the vast majority of people to resort to relatively crude and inefficient forms of fuels to meet cooking and heating requirements. Biomass fuels are the obvious choice in these cases. Livestock is a common feature of rural life. A significant proportion of livestock is maintained on commercial basis. In 2005, Grameen Shakti launched a biogas program that aimed to capitalize the potential livestock sector to generate biogas. In this respect, biogas systems were offered both on the domestic and commercial level. Compared to traditional means of cooking, biogas systems offer much more efficient, quicker and environmentally cleaner mode of cooking. Biogas micro-utility systems are also quite popular as the owner of the system can make healthy profit by selling the gas to neighbors.

The number of the installed biomass systems has increased from 30 in 2005 to over 14,300 in 2010 as shown in Fig. 3 [14]. The economic pay-back period of biogas systems have been observed to be as little as one year. Estimates suggest that there is a potential for up to 4 million biogas systems in the country [15].

4.1.3. Improved cooking stove systems

The majority of the population in Bangladesh relies on biomass for cooking and heating. Estimates, for example, suggest that around 94% of the domestic cooking needs are met from biomass sources [16]. The efficiency of these stoves is extremely low, typically between 5% and 15%. Furthermore, since, mostly cooking is an indoor activity, the indoor air pollution generated from the biomass burned in these stoves results into serious respiratory diseases and infections [4].

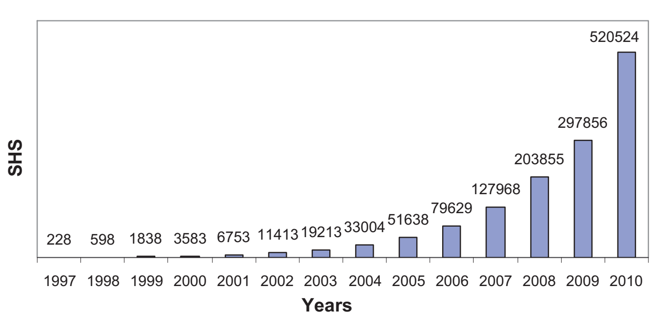


Fig. 2. Cumulative growth of installed solar home systems.

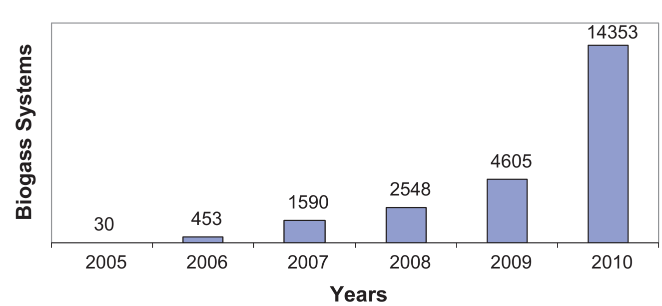


Fig. 3. Cumulative growth of installed biogas systems.

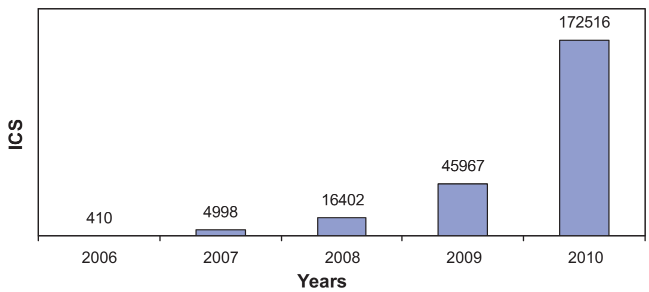


Fig. 4. Cumulative growth of installed improved cooking stoves.

In order to improve the health conditions and to save the amount of fuel consumed for cooking, Grameen Shakti has introduced improved cooking stoves (ICSs). An ICS not only improves the indoor health conditions by exhausting all the smoke and pollutants to outdoor but also reduces the cooking time. It also brings almost 50% saving in terms of fuel cost. Furthermore, by reducing the amount of wood and biomass fuel required for cooking, improved cooking stoves are benefiting the environment at large by helping reduce the rate of deforestation. The ICS program, started in 2006, has attracted huge interest from public as is evident from the exponential growth in the number of the installed systems both in the domestic and commercial sector – the number of installed ICSs has jumped from 410 in 2006 to over 172,000 in 2010 as indicated in Fig. 4 [14].

4.2. Operational framework

Owing to its novel business model, Grameen Shakti is one of the largest and the fastest growing micro-generation renewable energy programs in the world. Some of the most important features that have contributed to the success of Grameen Shakti are as followings.

4.2.1. Micro-credit based financial model

One of the key drivers behind the success of Grameen Shakti is its supportive financial model. The vast majority of its targeted customers-base – households and businesses in rural areas – cannot afford to purchase a SHS or biogas system at their own. Through its micro-credit program, Grameen Shakti offers a range of financial and technical support packages to make these renewable technologies affordable for its customers. Presently, GS is offering four options to its customers as shown in Table 2 [15].

4.2.2. Vast operational network

In order to support its typical business model and growth strategies Grameen Shakti has ensured its expansion in terms of not only human resource but also infrastructure. In this respect, since 2001, a great emphasis has been placed on the extension of operational/field network across the country. Having operated from its headquarter in Dhaka for the first 5 years, in 2001 GS decided to expand its network, setting up 49 branch offices across the country by the following year. The primary aim of branch offices was to improve the sales and after sales services. Regional offices were also established to coordinate the newly created branch offices. Gradually many of the functions of the headquarter were decentralized to the regional offices. Presently there are 972 branch offices across the country, which are coordinated by 128 regional offices as indicated in Table 3 [15].

These regional offices are further governed by 13 divisional offices that subsequently report to the headquarter. Similarly, the employee base has jumped from around 50 in 2001 to over 8500 in 2010 [17].

Table 2
Financial options available to Grameen Shakti customers.

Package	Down payment	Monthly instalments	Service charge (flat rate)
1	15%	36	6%
2	25%	24	4%
3 (for micro-utility)	10%	42	None
4	100% cash payment with 4% discount		

Table 3
Network-growth of Grameen Shakti.

Year	Employees	Branch offices	Regional offices
2002	88	49	8
2003	134	79	10
2004	201	105	17
2005	392	125	20
2006	906	227	32
2007	1683	340	55
2008	3155	515	77
2009	5053	670	104
2010	8510	972	128

4.2.3. Cost-effective production

In order to develop its renewable energy systems at a lower cost, Grameen Shakti aims to develop as much of the constituent components locally as possible. In this respect, it has set-up a strong base of manufacturing and assembling facilities. In case of solar home systems, for example, it locally develops a number of auxiliary components including charge controllers, lights and mobile chargers. Ultimately, the benefit of this strategy helps the customer in terms of reduced system cost. It has also helped GS develop a large pool of renewable technicians in the country.

4.2.4. Grameen Technology Centers

In 2006 Grameen Shakti developed 14 Grameen Technology Centers (GTCs) with the following main objectives.

- Improve the supply network for renewable technologies.
- Expedite after sales services.
- Reduce repair and maintenance cost.
- Train female technical staff (see Fig. 5).
- Promote local female entrepreneurs.
- Train customers.
- Educate public.



Fig. 5. Women technicians assembling components of solar home systems at a Grameen Training Center.

The establishment of GTCs has been a very successful initiative and there are now 46 GTCs across the country. These centers have greatly contributed to the rapid growth and expansion of Grameen Shakti in recent years. GTCs have already trained over 3000 female technicians who are either working at these centers or are working as renewable entrepreneurs [15].

4.2.5. Micro-utility systems

In order to adopt the customers that cannot afford a solar home system or a biogas system of their own, Grameen Shakti has introduced micro-utility models of these technologies. In this case, the system is owned by an individual customer who becomes a micro-utility by selling the generated electricity/gas to neighbors. There are now more than 10,000 micro-utility systems that are mostly used within the commercial sector [15].

5. Conclusions

The Grameen Shakti energy program provides micro-generation renewable systems to the rural population of Bangladesh which lacks access to the conventional electricity and gas networks. The program has grown at a remarkable rate over the last 14 years. Having installed over 520,000 solar home systems, over 14,300 biogas systems and 172,000 improved cooking stoves, Grameen Shakti has reached to around three 3.5 million people. The credit of its accomplishments goes to its innovative business model. The key drivers of its success include micro-credit based financial model, vast operational network, cost-effective production, Grameen Technology Centers (GTCs) and micro-utility systems. In order to make renewable technologies affordable for its customers, Grameen Shakti offers them micro-credit assistance rather providing any direct grants or subsidies. In the wake of the growing trends of distributed generation across the world, Grameen Shakti can be a role model not only for the developing countries but also for developed countries.

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